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HORIZONTAL DIFFERENCES IN WATER QUALITY IN AN AREA OF LAKE SAIMAA POLLUTED BY WASTE WATERS

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KETTUNEN, I. 1979. Horizontal differences in water quality in an area of Lake Saimaa polluted by waste waters. Publications of the Water Research Institute, National Board of Waters, Finland, No. 34.

An investigation carried out in a part of Lake Saimaa affected by waste waters from cellulose factory indicated that the quality of littoral water differed considerably from that of the main body of water. The most marked differences were in oxygen concentrations, which varied from 5.4 mg l^{-1} in littoral water to 1.9 mg l^{-1} in the open lake. When planning investigations of polluted waters the possibile occurrance of such horizontal differences should be taken into consideration.

Index words: Water quality, horizontal differences, pollution.

1. INTRODUCTION

The true residence time of water in chains of lakes is often considerably less than that calculated on the basis of lake volume (Kettunen 1971). The effects of waste waters therefore extend further down the watercourse than dilution calculations indicate. Waste materials carried by the stream may for the same reason be more "raw", with correspondingly greater effect on water quality, in chain lakes with a strong current than in solitary lakes situated apart from the mainstream of water movement.

2. METHODS

In an investigation carried out in June 1973 water quality was examined from three sampling lines, in the southern region of Lake Saimaa, along the route followed by waste waters emitted by the factory of Kaukas Oy (Fig. 1). In addition one sampling line was chosen in a non-polluted area of Greater Saimaa. Water quality from each point of sampling was examined by means of a vertical series of water samples. The samples were analysed in the laboratory of National Board of Waters Kymi district office

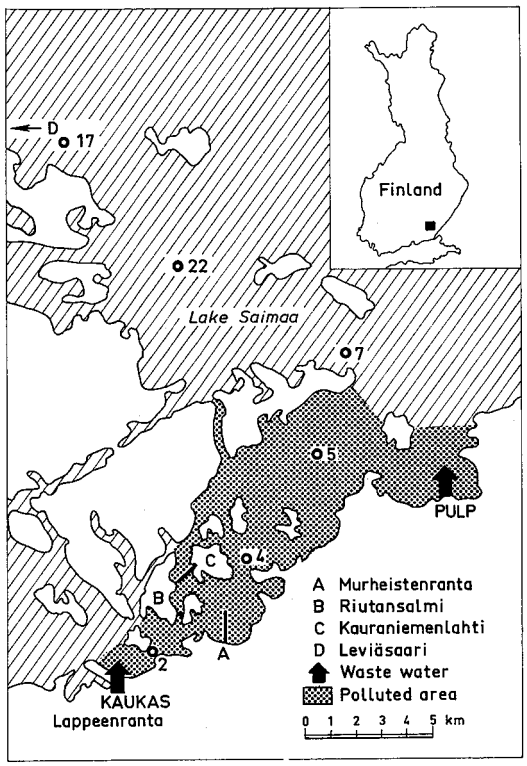

Fig. 1. The southern region of Lake Saimaa.

using methods conforming to SFS standards. The results are presented as profile figures. The water region being investigated was polluted by waste waters from forest industries. Oxygen concentrations in the water occasionally fell to below the tolerance threshold of fish populations, with consequent death of the fishes.

3. RESULTS

The sampling line A (Murheistenranta) was situated in a polluted littoral zone about 3 km from an effluent discharge point. The oxygen concentration of water very close to the shore was found to be 5.4 mg l^{-1}, while 300 m from the shore concentrations were only 1.9 and 2.2 mg l^{-1} in surface layers and deeper water, respectively (Fig. 2).

Results from the sampling line B (Riutansalmi) showed that the most strongly polluted water was at a depth of 3–5 m (Figs. 3 and 4).

Sampling line C (Kauraniemenlahti) presents a closed, eutrophic bay. Increased oxygen concentration and turbidity recorded in the centre of the bay were probably the result of algal growth (Figs. 5 and 6).

Sampling line D, in a non-polluted area of Lake Saimaa, was situated in the comparatively open bay of Leviäsaari (Figs. 7 and 8). In the more eutrophic region near to the shore COD-values were considerably higher than in the open lake.

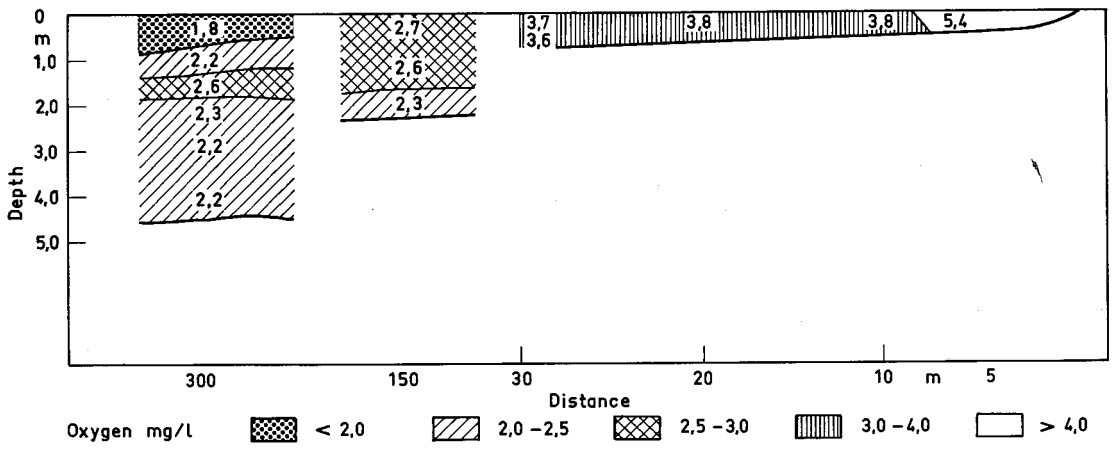

Fig. 2. Oxygen concentration. Sampling line A.

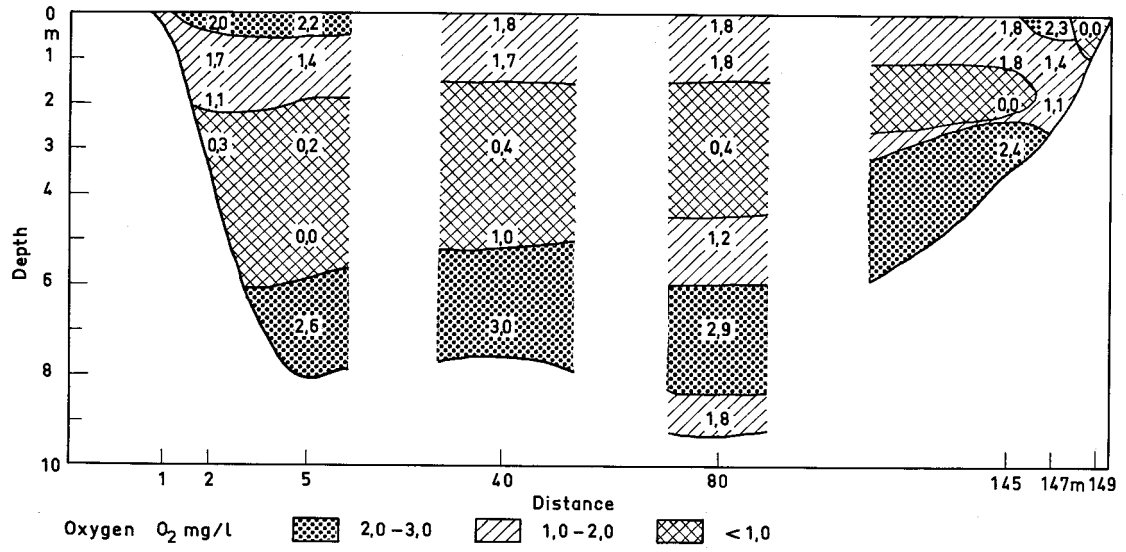

Fig. 3. Oxygen concentration. Sampling line B.

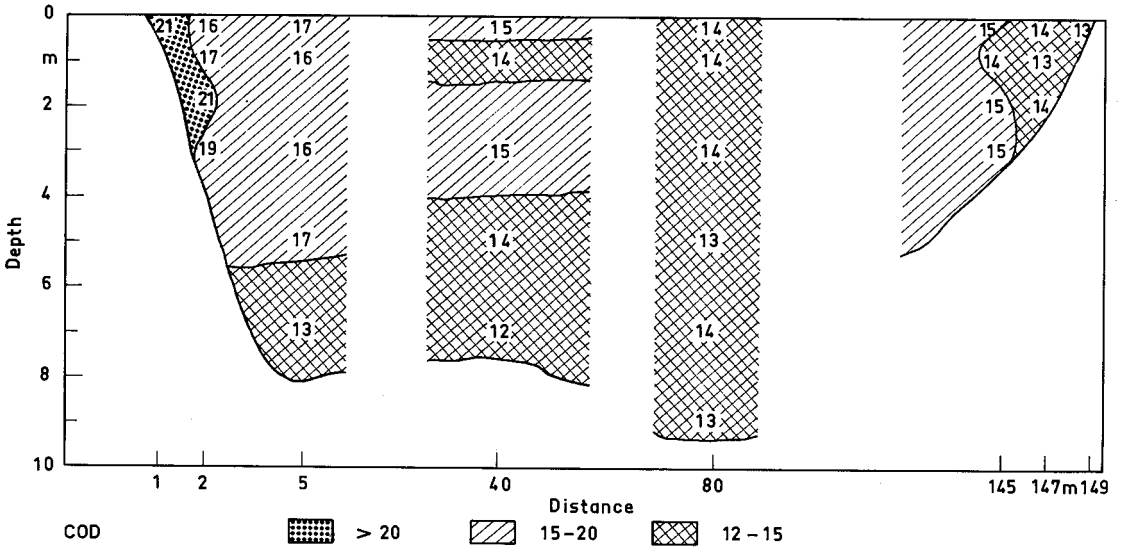

Fig. 4. Chemical Oxygen Demand (COD). Sampling line B.

4. DISCUSSION

The research carried out shows that a water mass may be divided into areas of different quality in a rather exceptional manner. The boundaries of stratified water levels are determined by prevailing currents. In polluted areas stratification may also be due to the difference in density between effluent and non-polluted lake water. This has the effect that the effluent does not readily become diluted in the main body of water, but develops instead its own path of flow through the lake. This is clearly noticable in narrow sounds typical of the southern region of Lake Saimaa (Heinonen, Alhonen and Kettunen 1971). The present research also showed that vertical water quality boundaries do not approach the shore rectilinearly but rather follow the rising of

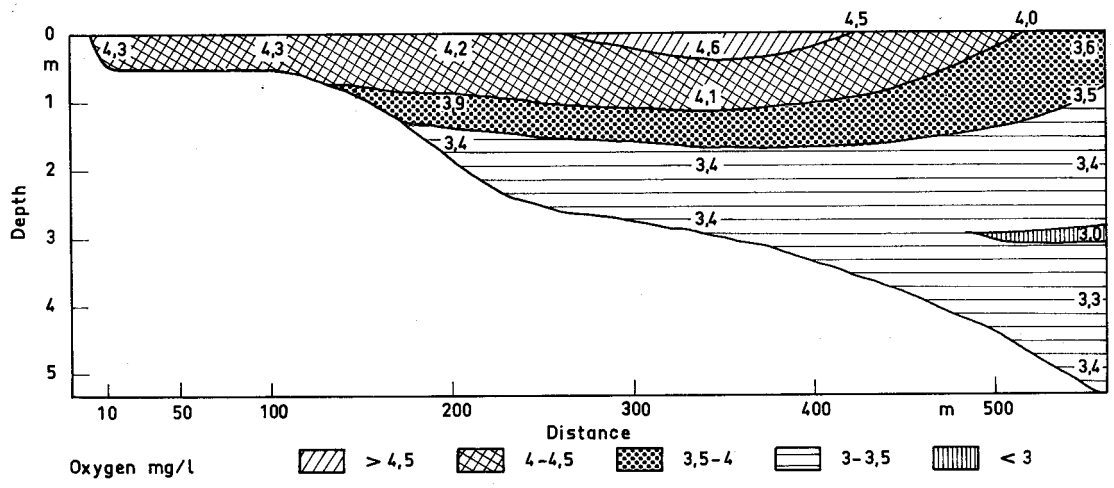

Fig. 5. Oxygen concentration. Sampling line C.

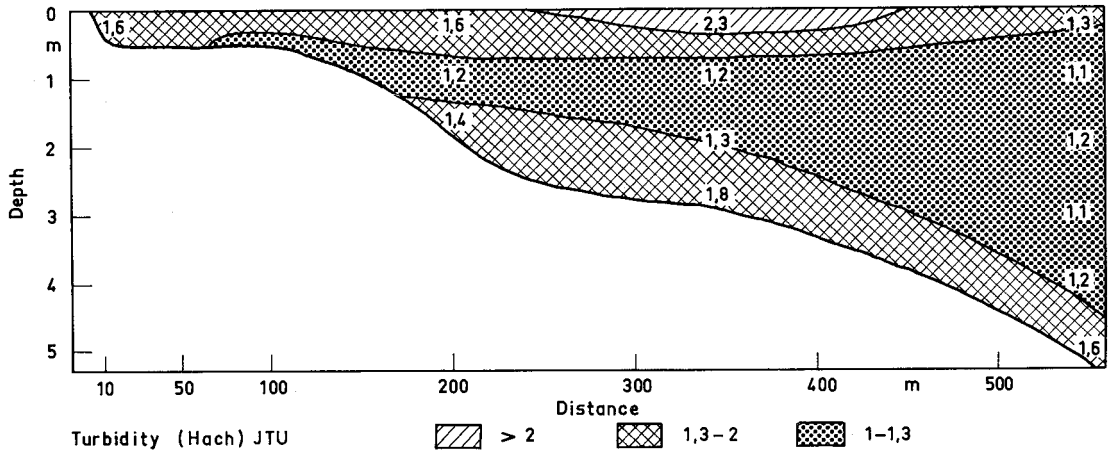

Fig. 6. Turbidity. Sampling line C.

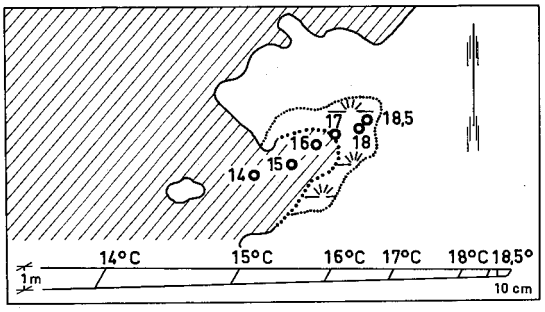

Fig. 7. Temperature. Sampling line D.

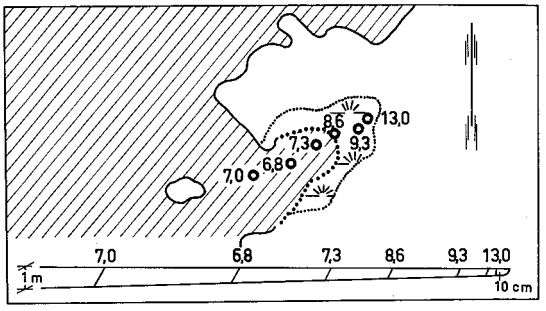

Fig. 8. Chemical Oxygen Demand (COD). Sampling line D.

the lake bottom towards the shore. In the shallow water near the shore photosynthetic and biodegrading activity have a particular effect on water quality.

LOPPUTIIVISTELMÄ

Veden laadun horisontaalisia eroja on tutkittu Etelä-Saimaalla selluteollisuuden pahoin likaamalla vesistöalueella. Merkittävimmät erot on havaittu happipitoisuudessa. Litoraalivyöhykkeessä oli liuenneen hapen määrä lähes kolminkertainen verrattuna päällysveden arvoihin järven syvemmillä alueilla.

REFERENCES

Heinonen, P., Alhonen, P. & Kettunen, I. 1971. Jäteveden talvisesta kerrostumisesta hitaasti virtaavissa järvialtaissa. Vesitalous 3:42–44.

Kettunen, I. 1971. Havaintoja veden virtauksista reittijärvessä. Vesitalous 5:11–12.